WHAT IS THE LIFETIME OF AN LED?

The Illuminating Engineering Society of North America (IESNA) published the TM-21-11 as a method to predict long-term lumen maintenance of LED light sources.

LM-80 *Testing*	+	**TM-21** *Projections*	=	**USEFUL** *Information*
LM-80 provides a method for the measurement of lumen maintenance of LED package, arrays and modules. LM-80 does not entail testing of the entire luminaire or provide guidance or make any recommendations regarding predictive estimates or extrapolation beyond actual measurements.		TM-21 is the IESNA approved method of predicting long term lumen maintenance of the LED. The projections are limited to 6x data set. It also helps to project L_{70} for LEDs.		L_{70} should be within 6x testing time of LM-80 data. If the L_{70} does not occur within 6x testing time, the result is reported as ">60,000 hrs." Beyond 6x testing time the values are considered to be high risk as shown in Figure 1. TM-21 can project L_{70} of the fixture from the in-situ temperature.

TM-21 PROJECTION FROM THE LM-80 RESULTS

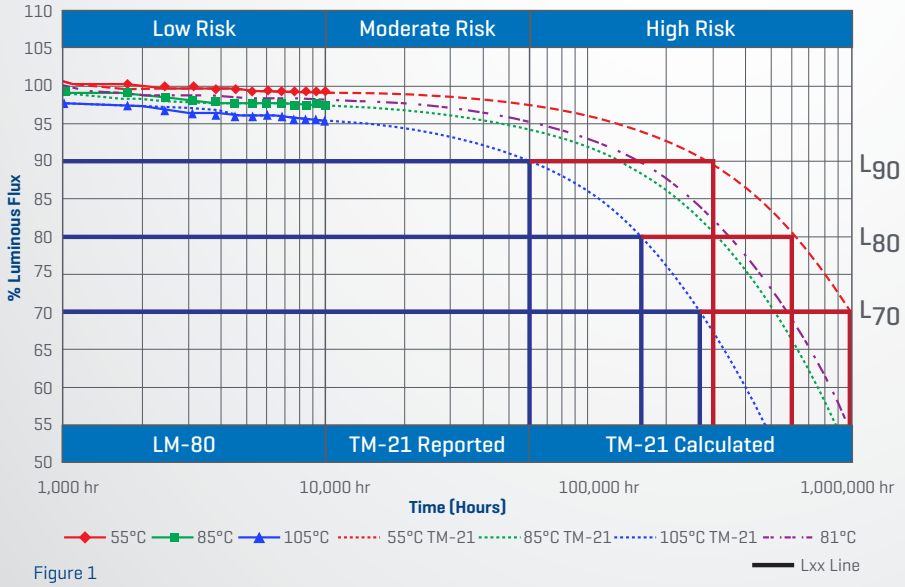

Figure 1

NOMENCLATURE: L_p (DK):

p = The percentage of initial lumen output that is maintained

D = The total duration of the test in hours divided by 1000 and rounded

EXAMPLE: L_{70} (10K)-Where

L_{70} – 70% of initial lumen output

10K - Total duration of test 10,000 hrs

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From the LM-80 data using the TM-21 calculator the lumen maintenance can be determined for any lifetime such as L_{70}, L_{80} or the L_{50}.

EXAMPLE

As an example, to predict the lifetime of the TKD–2x4–XL–F–UL–35K–FRL, the 10,000 hours LM-80 data for the LED chip, NS2L757A-V1, is used. The manufacturer published lumen maintenance of the chip at 55°C, 85°C and 105° is shown in Figure 2.

CALCULATING L_{70}

Based on the in-situ temperature of the fixture, the TM-21 calculator using the LM-80 data of the LED chip manufacturer can be used to calculate the L_{70} of the fixture. For this TKD, the in-situ temperature was found to be 42.2°C (lumen maintenance not shown in Figure.2). Table 1 provides the L_{70}, L_{80}, L_{90}, and L_{98} value using the TM-21 calculator.

REPORTING L_{70} VALUES

If the calculated value from the TM-21 calculator exceeds 6x testing time, the value is considered to be high risk. The reported value should NOT be represented as the calculated value if it exceeds the 6x testing time. From Table 1, it can be seen the L_{70} calculated value is 107,000 hrs which exceeds 6x testing time or 60, 000 hrs. Hence, the reported value should be represented as ">60,000 hrs."

CONCLUSION

Thus the lifetime prediction for the LED fixture from TM-21 should be reported accurately. This lifetime prediction depends on several factors such as LM-80 test duration and in-situ temperature of the fixture.

LM-80 LUMEN MAINTENANCE DATA FOR NS2L757A-V1 CHIP

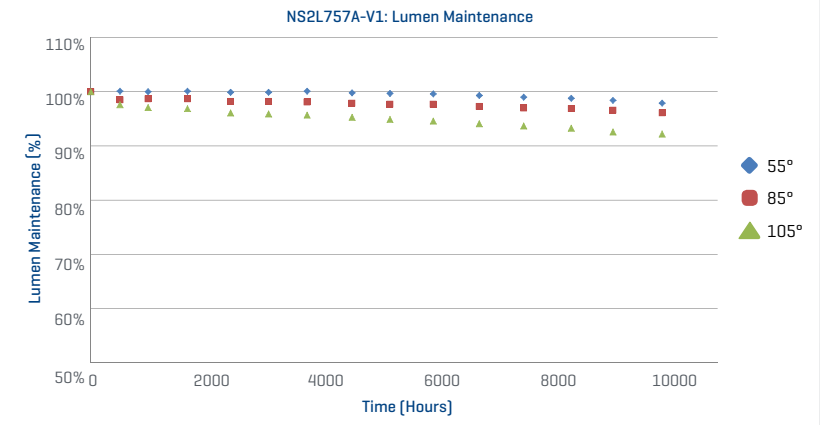

Figure 2

DETERMINING THE L_{70}, L_{80}, L_{90}, L_{98} OF THE TKD-2X4-XL-F-UL-35K-FRL

TKD-2X4-XL-F-UL-35K-FRL	Low Risk (LM-80)	Moderate Risk (TM-21 Reported)	High Risk (TM-21 Calculated)
L_{70} (10K)	N/A	>60,000 Hours	107,000 Hours
L_{80} (10K)	N/A	>60,000 Hours	69,000 Hours
L_{90} (10K)	N/A	35,000 Hours	35,000 Hours
L_{98} (10K)	10,000	10,000 Hours	10,000 Hours

Table 1

THE LED SYSTEM RELIABILITY IS DEPENDENT ON THE PERFORMANCE OF SEVERAL FACTORS:

- **LEDS**
  Semiconductor failure, wire bond failure, solder joint fatigue, phosphor quenching.
- **ELECTRONICS**
  Electrical overstress, driver failure, failure of external control gear.
- **COOLING SYSTEM**
  Improper design of housing, high resistance between PCB & LED.
- **MECHANICALS**
  Improper heat sinking, not vibration resistant/IP rated, improper bonding of components.
- **OPTICS**
  Encapsulant failure (yellowing, carbonization), lens cracking.